WO 2005/058185 PCT/IB2004/052732

## CLAIMS:

1. A pumping system for pumping an oral composition used in the treatment of the oral cavity, comprising:

a pumping system for moving an oral composition useful in the treatment of the oral cavity having a selected viscosity from a reservoir of an oral treatment system to an outlet of the system, the pumping system including a pump and a fluid pathway for the oral composition to reach the outlet, wherein the pump is so characterized and the pathway has an internal cross-sectional area (A) within the range of  $0.25 \text{ mm}^2$ - $16 \text{ mm}^2$  and a length (y) within the range of 100 mm-200 mm and is otherwise so characterized by such a cross-sectional shape and cross-sectional uniformity along its length that an oral composition with a minimum viscosity of 10 Pa.s at a shear rate of  $1\text{s}^{-1}$  and a maximum viscosity not greater than  $\eta(\text{in Pa.s})$  at a shear rate  $\gamma(\text{in s}^{-1})$  defined as follows:

$$\eta = \frac{250A^2}{4v} \text{ and } \gamma = \frac{2500}{A^{3/2}}$$

can be moved to the outlet by the pump at a rate of at least 0.1 ml per second.

- 2. The pumping system of claim 1, wherein said rate is preferably approximately 0.2 ml per second.
- 3. The pumping system of claim 1, wherein the fluid pathways are flexible tubing and the internal cross-sectional area of the tubing is within the range of 0.5 mm<sup>2</sup> to 10 mm<sup>2</sup> and the length of the tubing is from 120 mm to 180 mm.
- 4. The pumping system of claim 1, wherein the pump is a positive displacement pump.
- 5. The pumping system of claim 1, wherein the oral treatment system comprises a hand-held toothbrush which includes a housing grippable by a user's hand, wherein the housing contains the reservoir.
- 6. The pumping system of claim 5, wherein the toothbrush is an electric toothbrush.
- 7. The pumping system of claim 4, wherein the positive displacement pump is a diaphragm pump.
- 8. The pumping system of claim 1, wherein the reservoir has an internal volume of between 5 ml and 25 ml.
- 9. The pumping system of claim 3, wherein the tubing has a length to internal cross-section area ratio of at least 1:1 ml<sup>-1</sup>.
- 10. A system for treatment of the oral cavity, comprising:

WO 2005/058185 PCT/IB2004/052732

an oral composition suitable for treatment of the oral cavity;

a reservoir for the oral composition; and

a pumping system for moving the oral composition from the reservoir to an outlet of the treatment system, the pumping system including a pump member and a fluid pathway tube for the oral composition to reach the outlet, wherein the pump is so characterized and the fluid pathway tube has a cross-sectional area (A) within the range of  $0.25 \text{ mm}^2$  to  $16 \text{ mm}^2$  and a length (y) within the range of 100 mm-200 mm and otherwise so characterized by a selected cross-sectional shape and uniformity of cross-sectional configuration along its length relative to the oral composition with a minimum viscosity of 10 Pa.s and a shear rate of  $1s^{-1}$  and a viscosity not greater than  $\eta$ (in Pa.s) at a shear rate  $\gamma$ (in  $s^{-1}$ ), defined in the following equations:

$$\eta = \frac{250A^2}{4Y} \text{ and } \gamma = \frac{2500}{A^{3/2}}$$

that said composition can be moved to the outlet by the pump at a flow rate of at least 0.1 ml per second.

- 11. The system of claim 10, wherein the fluid pathway tube has an internal cross-sectional area within the range of 0.5 mm<sup>2</sup> to 10 mm<sup>2</sup> and a length within the range of 120 mm to 180 mm.
- 12. The system of claim 10, wherein the reservoir has an internal volume of between 5 ml and 25 ml.
- 13. The system of claim 10, wherein the flow rate is preferably 0.2 ml per second.
- 14. The system of claim 10, wherein the oral treatment system includes a hand-held toothbrush which can be gripped in the user's hand, wherein the housing contains the reservoir and the outlet is within a bristle portion of the toothbrush.
- 15. A method of treatment of the oral cavity, comprising the steps of:

moving an oral composition suitable for treatment of the oral cavity with a pumping system from a reservoir to an outlet of an oral treatment system, the oral treatment system comprising a toothbrush having a brushhead with an outlet suitable for insertion into the oral cavity, the pumping system including a pump and a fluid pathway tube for an oral treatment composition, wherein the pump is so characterized and the fluid pathway tube has an internal cross-section diameter (A) within the range of 0.25 mm<sup>2</sup> to 16 mm<sup>2</sup> and a length (Y) within the range of 100 mm to 200 mm and is otherwise so characterized by a cross-sectional shape and uniformity of cross-sectional configuration that the oral

WO 2005/058185 PCT/IB2004/052732

composition is moved to the outlet at a flow rate of at least 0.1 ml per second, wherein the oral composition has a minimum viscosity of 10 Pa.s and a shear rate of 1 s<sup>-1</sup> and a maximum viscosity not greater than  $\eta$ (in Pa.s) at a shear rate  $\gamma$  (in s<sup>-1</sup>), defined by the following equation

$$\eta = \frac{250A^2}{4Y} \text{ and } \gamma = \frac{2500}{A^{3/2}}$$

- 16. The treatment method of claim 15, wherein said flow rate is approximately 0.2 ml per second.
- 17. The treatment method of claim 15, wherein the reservoir has an internal volume of between 5 ml and 25 ml.
- 18. The treatment method of claim 15, wherein the fluid pathway has a cross-sectional area within the range of  $5 \text{ mm}^2$  to  $10 \text{ mm}^2$  and a length within the range of 120 mm to 180 mm.